

Maeve Goldberg  
Asheville High School  
Asheville, North Carolina  
Bangladesh, Malnutrition

### **Micronutrient Fortification: A Pragmatic Solution to Bangladeshi Malnutrition**

In the UN's decade of action on malnutrition, a positive end to the decades-long battle for a healthy world seems ever more possible. Chosen as one of the World Health Organization's top five strategies for combating malnutrition globally, micronutrient fortification is a proven, effective method way to ensure that those who are most at risk can avoid or overcome malnutrition. But while health outcomes improve when foods are fortified, implementing a micronutrient fortification program on a large scale comes with challenges that often prevent this life-saving measure from reaching vulnerable populations. Nowhere is this more evident than in Bangladesh, the world's eighth most populous nation.

A country of 166 million people, Bangladesh is considered a developing nation by the World Bank. While recovering from 20th century regional conflicts, Bangladesh moved into a stratified role as an economy dependant on exports to the west. The clothing and textile industries account for approximately 76 percent of the country's exports and employ over two million Bangladeshis. Western companies push for cheap production, which keeps wages low with the minimum wage equivalent to only \$38 US dollars a month. For many families this wage is not enough to pay for electricity or telephones and fresh and healthy food.

Agriculture is another of Bangladesh's main industries, supplying approximately 60 percent of the employment in Bangladesh and 30 percent of its total economy. The main crops are cereals such as rice and wheat, and jute, which easily flourish in most of the 35,500 square miles of cultivated land in the country. The subtropical climate of Bangladesh is good for growing, however monsoons seasons can easily flood the low lying plains, the location of some of the farms. Most people in Bangladesh live on farms or in rural areas, only 36 percent of the population lives in urban centers. The rural population is particularly at risk to health problems such as malnutrition and disease because of limited healthcare facilities available.

The UN Food and Agriculture Organization estimates that 9.5 million children in Bangladesh experience the harmful effects of malnutrition. In addition, the rates of micronutrient deficiency in Bangladesh are among the highest in the world. According to the Orphan Nutrition project, micronutrient deficiency is "a lack of essential vitamins and minerals required in small amounts by the body for proper growth and development." Micronutrient malnutrition affects approximately two billion people worldwide, primarily women and children. In Bangladesh, studies indicate that one-third of preschool children face anemia due to nutrient deficiencies, as do one-quarter of all women. Vitamin D and zinc deficiencies are among the most common, with about 40 and 45 percent of preschool-age children affected respectively. Rural women are particularly affected and limited in healthcare due to gender discrimination.

In fact, gender inequality and malnutrition are inextricably linked in Bangladesh and in much of the developing world. The status of women in a family household can be an indicator of the nutrition of the whole family. A 2010 Study by the South Asia Human Development Fund examining the relationship between gender and nutrition in Bangladesh found that families headed by women in regions of rural Bangladesh are statistically more likely to be food insecure and malnourished than male-headed households. The study also examined factors that impact the empowerment of Bangladeshi women,

including, “decision-making abilities; control of household resources (cash); experience and perception on domestic violence; and political participation.” Using these factors they determined that the greater empowerment of women in Bangladeshi households has a direct positive association with greater nutrition in both the children in the family and the women themselves. Since women and children are the most vulnerable to and most affected by micronutrient malnutrition, and the World Bank estimates that 13% of Bangladeshi households are headed by women, this is an important aspect of the issue to consider in micronutrient malnutrition reduction programs.

Currently, though the country has made significant gains in reducing malnutrition (reducing its overall rates of malnutrition by one to two percent per year over the past two decades), micronutrient malnutrition has not received the same amount of attention and funding by various government and NGO programs as other malnutrition issues, and so remains a top health issue in the Bangladeshi population.

Micronutrient deficiencies stem from the Bangladeshi diet, which consists mainly of rice. Rice is a high-calorie food, and therefore provides energy, but lacks many vital nutrients. The USDA Nutrient Database shows that 100 grams of cooked rice can provide 123 kcals of energy, but only 0.56 of a milligram of zinc and 0 micrograms of vitamin B12 and vitamin D. Though these nutrients can be obtained through other foods, many Bangladeshi families living on a small monthly wage cannot afford to provide consistently healthy meals necessary for childhood development. Because these vitamins are essential to proper human growth, children are especially vulnerable to the health risks associated with micronutrient deficiencies. For example, zinc is important to the body’s immune system (protecting from viral and infectious diseases) and vitamin D is needed for healthy bone growth.

Micronutrient deficiencies are also the cause of “hidden hunger.” Chronic lack of vitamins and minerals leads to deficits in physical and mental development, limiting human potential in both children and adults. A child who suffers from hidden hunger may lag behind in learning and growth, never be able to catch up. This has repercussions not only for the individual, but for the society as a whole.

The obvious solution to micronutrient deficiency caused by a rice-heavy diet is to encourage more diverse and nutrient-rich eating habits. The government of Bangladesh has released a set of nutritional guidelines for healthy and balanced diet in partnership with the FAO that encourages cereals (such as rice) and fruits and vegetables to be eaten in generous amounts, and the government considers the implementation of the guidelines to be “one of the priority interventions” of food and agriculture policy. However for the average family in Bangladesh, eating by these guidelines remains challenging. Because most of Bangladeshi agricultural land is devoted the production of cereal crops, and because of the volatile rainy seasons, cultivation of fruits and vegetables is limited and it’s difficult to provide enough for the immense population. This in turn causes local prices for fresh fruits and vegetables to increase.

Another clear solution would be to directly provide capsulated nutritional supplements. This strategy is known to be effective in small scale ventures; the WHO provided nutrient supplements to 4,011 pregnant women in Bangladesh and found that the children born to these mothers were healthier than the average. However, programs based on oral supplements to reduce micronutrient malnutrition have some limitations because they require frequent dosages to be effective, and they could be hard for rural Bangladeshis to access consistently. The cost is also an issue.

Rice provides the the most pragmatic, sustainable, and achievable solution to the micronutrient malnutrition problem in Bangladesh. One rice-based malnutrition fighting program called The Golden Rice Project has been in development for over 30 years. Golden rice is a biofortified rice crop genetically engineered with high vitamin A content. One typical portion of golden rice can provide 60 percent of a child's daily recommended vitamin intake. Experimental modifications in rice genes have shown promising increases in iron and zinc levels as well. There are several problems with biofortified rice crops, however. After years of testing, Golden Rice has been ready to be commercially grown since 2013. However, there have been controversies about the way the rice was tested and some reports indicate that it doesn't deliver on its promise of increasing vitamin A. Because of some strong objections to genetically modified food, governments are wary of approving this type of product.

Other biofortified foods have been useful in reducing malnutrition around the world. The 2016 World Food Prize was awarded to a group of scientists who developed a biofortified sweet potato that could be grown strongly in Sub-Saharan Africa. Their project included education for farmers on the newly developed plant, as well as modifications to make the crop high-yield and drought-resistant, and impacted nearly two million African families across several nations. If a safe biofortified rice crop could be introduced into Bangladesh's highly productive rice agriculture industry, it would likely reduce micronutrient deficiencies across the country.

Another possible solution is rice fortification. Rice can be fortified with many different nutrients by several different methods including hot and cold extrusion, coating, and powder enrichment. In developing nations, programs have deemed that extrusion methods provide the most nutrients, and well as being the most efficient processes. The cold extrusion method consists of creating a dough like mixture of rice flour and vitamins and pressing it into the shape of rice grains. These grains can provide the necessary nutrients within the same typical portion size. The UN World Food Programme led a two-year (2012-2014) fortified rice program in an Indian province in which cold extrusion fortified rice was used in school provided meals. The program involved the distribution of 1,942 metric tons of fortified rice throughout all the schools in the district grades 1 through 8 as well as training for school staff on the processes of the program so eventually the WFP can leave program to be managed by the locals. The main problem with this program that would limit its effectiveness in Bangladesh is the scope of distribution. Though most children go to primary school (98%), five million very poor and rural children do not, and they are the ones among the most susceptible to micronutrient malnutrition. Also only 54 percent of children in Bangladesh attended secondary school, and girls are far less likely to remain than boys, so access to school-based programs for those who do not continue would end when they left primary school.

Although these stand-out programs have been creating change through rice, rice fortification has not yet been used to its full potential in Bangladesh. The main problem with current programs lies in the scope and demographic of the people they benefit. The questions we must ask are: how do we spread solutions to the entire affected community, and how can we craft a solution that takes into account the nutrition-gender link?

The answer is that eradicating micronutrient malnutrition in Bangladesh is not possible through just one program. Each single solution has limitations in terms of who it can benefit and how effective it will be, so a combination of strategies must be applied to pragmatically and completely solve for this issue.

The first step lies in Bangladeshi government policy. The government in Bangladesh is very concerned about malnutrition and in the past has been eager and successful in creating laws and regulations concerning nutrition. One step the government could take would be to have a set of standards for processed rice be fortified. Policies like this have been implemented around the world. For example, in the United States in the early 40's, the Food and Nutrition Board supplied a list of nutrients that should be added to flour and the FDA made a set of standards for enriched flour. The Bangladeshi government could also approve and help implement the use of biofortified rice crops. Non-governmental organizations such as the World Food Program's distribution of fortified rice through school should also be continued with expanded reach, perhaps through the creation of regional nutritional health centers. However, the gender issue still remains. With many girls unable to attend school and women unable to leave their village without the consent of a male relative, even expansion of programs like the WFP's could not be totally effective.

NGO programs and government policy have to be designed specifically with gender in mind. The Bill and Melinda Gates Foundation has established a set of guidelines for "Creating Gender Responsive Agricultural Programs" in order to make sure the programs they fund benefit women and communities. The guidelines explain that programs aimed at helping a general population are not as effective as "gender aware" programs because "women can be further marginalized if their concerns and needs are not explicitly factored into the program design."

A holistically effective nutrition plan for Bangladesh could train women in the farming of a biofortified rice crop, and include grants and training for agricultural technology and balanced diets, as well as focusing on the empowerment of young girls and mothers. According to the Gender Responsive Programs guidelines, "When women farmers are meaningfully included in agricultural development opportunities, not only do farms become more productive but adoption of new technologies increases and overall family health improves." This claim is backed up with research from global agricultural programs. The study further states that, "if women farmers across the developing world had the same access as men do to resources such as land, improved seed varieties, new technologies, and better farming practices, yields could increase by as much as 30 percent per household and countries could see an increase of 2.5 to 4 percent in agricultural output." These benefits could positively impact the entire country of Bangladesh, as well as individual Bangladeshi families. In addition, "Women have also been shown to be more likely than men to reinvest income in the health of children and other family members and in a more varied and nutritious family diet."

With funding from UN programs, NGOs, and bilateral national development funds (Australia in particular is promising to provide almost \$60 million in bilateral aid to Bangladesh in 2017-18 with a specific emphasis on ending poverty and its effects,) these several solutions can be implemented.

In conclusion, micronutrient malnutrition in Bangladesh is not a simple fix. A well balanced and varied diet is the ideal way to solve for the issue, but because this isn't possible for most Bangladeshis in the greatest need, specifically women and children, micronutrient fortification. Proven to deliver positive health outcomes at a lower cost relative to other solutions, micronutrient fortification can make an impact in reversing the statistics on malnutrition in Bangladesh. Combined with gender aware agriculture programs, and with cooperation among international organizations and the national and local government, all Bangladeshis can receive the nutrition they need to thrive.

#### Bibliography:

- “Bangladesh Population (LIVE).” *Bangladesh Population (2018) - Worldometers*,  
[www.worldometers.info/world-population/bangladesh-population/](http://www.worldometers.info/world-population/bangladesh-population/).
- \*“Elaboration of data by United Nations, Department of Economic and Social Affairs, Population Division. [World Population Prospects: The 2017 Revision](#).”
- “Bangladesh: Government.” *GlobalEDGE*, Michigan State University ,  
[globaledge.msu.edu/countries/bangladesh/government](http://globaledge.msu.edu/countries/bangladesh/government).
- “Agricultural Land Bangladesh.” *The World Bank Data*, The World Bank,  
[data.worldbank.org/indicator/AG.LND.AGRI.K2?locations=BD](http://data.worldbank.org/indicator/AG.LND.AGRI.K2?locations=BD).
- Baki, Abdullah Hel, et al. “Department Of Agricultural Extension Ministry of Agriculture.”
- Rapsomanikis , George. “The Economic Lives of Smallholder Farmers.” Food and Agriculture Organization of the United Nations, 2015.

“Climate of Bangladesh .” *Climate of Bangladesh*, National Environmental Agency of Singapore, [www.nea.gov.sg/weather-climate/climate/climate-of-cities-in-asia/climate-of-bangladesh](http://www.nea.gov.sg/weather-climate/climate/climate-of-cities-in-asia/climate-of-bangladesh).  
Tinker, Hugh Russell, and Syed Sajjad Husain. “Bangladesh.” *Encyclopedia Britannica* , Encyclopedia Britannica , [www.britannica.com/place/Bangladesh](http://www.britannica.com/place/Bangladesh).

Ahmed, Faruk, et al. “Micronutrient Deficiencies among Children and Women in Bangladesh: Progress and Challenges.” *Journal of Nutritional Science*, Cambridge University Press, 2016, [www.ncbi.nlm.nih.gov/pmc/articles/PMC5465809/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5465809/).

“Nutrition Country Profiles: Bangladesh.” *Nutrition and Consumer Protection*, Agriculture and Consumer Protection Department, [www.fao.org/ag/agn/nutrition/bgd\\_en.stm](http://www.fao.org/ag/agn/nutrition/bgd_en.stm).

“Micronutrient Malnutrition.” *A Child's Best Start, Orphan Nutrition*, [www.orphannutrition.org/understanding-malnutrition/micronutrient-malnutrition/](http://www.orphannutrition.org/understanding-malnutrition/micronutrient-malnutrition/).

“Basic Report: 20037, Rice, Brown, Long-Grain, Cooked.” *United States Department of Agriculture Agricultural Research Service National Nutrient Database for Standard Reference Release 28*, United States Department of Agriculture Agricultural Research Service, [ndb.nal.usda.gov/ndb/foods/show/6506](http://ndb.nal.usda.gov/ndb/foods/show/6506).

Roohani, Nazanin, et al. “Zinc and Its Importance for Human Health: An Integrative Review.” *Journal of Research in Medical Sciences : The Official Journal of Isfahan University of Medical Sciences*, Medknow Publications & Media Pvt Ltd, Feb. 2013, [www.ncbi.nlm.nih.gov/pmc/articles/PMC3724376/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3724376/).

DeNoon, Daniel J. “The Truth About Vitamin D: Why You Need Vitamin D.” *WebMD*, WebMD, [www.webmd.com/osteoporosis/features/the-truth-about-vitamin-d-why-you-need-vitamin-d](http://www.webmd.com/osteoporosis/features/the-truth-about-vitamin-d-why-you-need-vitamin-d).

“Improving on Micronutrients.” *Golden Rice Project Golden Rice Humanitarian Board*, [www.goldenrice.org/Content2-How/how6\\_mn.php](http://www.goldenrice.org/Content2-How/how6_mn.php).

Landis, Lauren. “Rice Fortification - A Neglected Tool in Fighting Malnutrition.” *World Food Programme Insight*, World Food Programme Insight, 23 Aug. 2017, [insight.wfp.org/rice-fortification-a-neglected-tool-in-fighting-malnutrition-ebd4d2821a6d](http://insight.wfp.org/rice-fortification-a-neglected-tool-in-fighting-malnutrition-ebd4d2821a6d).

“Rice Fortification – What Are the Methods to Fortify?” *Global Alliance for Improved Nutrition*, [www.gainhealth.org/knowledge-centre/rice-fortification-what-are-the-methods-to-fortify/](http://www.gainhealth.org/knowledge-centre/rice-fortification-what-are-the-methods-to-fortify/).

“WFP India: Improving Child Nutrition Through Rice Fortification In Gajapati.” *World Food Programme*, Feb. 2014.

“What Is the Status of the Golden Rice Project?” *International Rice Research Institute*, [irri.org/golden-rice/faqs/what-is-the-status-of-the-golden-rice-project](http://irri.org/golden-rice/faqs/what-is-the-status-of-the-golden-rice-project).

Nahar, Quamrun, et al. "Dietary Guidelines for Bangladesh." Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders June 2013.

Mridha, M K, et al. "Lipid-Based Nutrient Supplements for Pregnant Women Reduce Newborn Stunting in a Cluster-Randomized Controlled Effectiveness Trial in Bangladesh." *The American Journal of Clinical Nutrition.*, U.S. National Library of Medicine, Jan. 2016, [www.ncbi.nlm.nih.gov/pubmed/2660793](http://www.ncbi.nlm.nih.gov/pubmed/2660793)

"Bangladesh Industry Sectors." *Bangladesh Industry Sectors | Economy Watch*, [www.economywatch.com/world\\_economy/bangladesh/industry-sector-industries.html](http://www.economywatch.com/world_economy/bangladesh/industry-sector-industries.html). Global Reach Internet Productions, LLC - Ames, IA - globalreach.com. "2016 - Andrade, Mwanga, Low and Bouis." *The World Food Prize Foundation*, [www.worldfoodprize.org/en/laureates/2016\\_\\_andrade\\_mwanga\\_low\\_and\\_bouis/](http://www.worldfoodprize.org/en/laureates/2016__andrade_mwanga_low_and_bouis/).

Institute of Medicine (US) Committee on Use of Dietary Reference Intakes in Nutrition Labeling. "Overview of Food Fortification in the United States and Canada." *Dietary Reference Intakes: Guiding Principles for Nutrition Labeling and Fortification.*, U.S. National Library of Medicine, 1 Jan. 1970, [www.ncbi.nlm.nih.gov/books/NBK208880/](http://www.ncbi.nlm.nih.gov/books/NBK208880/).

Hoque, Enamul. "CROP DIVERSIFICATION IN BANGLADESH." *Fao.org*, [www.fao.org/docrep/003/x6906e/x6906e04.htm](http://www.fao.org/docrep/003/x6906e/x6906e04.htm).

Begum, M. "Factors Affecting Family Size in Rural Bangladesh." *Bangladesh Medical Research Council Bulletin.*, U.S. National Library of Medicine, Dec. 2004, [www.ncbi.nlm.nih.gov/pubmed/16240982](http://www.ncbi.nlm.nih.gov/pubmed/16240982).

"Overview of Australia's Aid Program to Bangladesh." *Department of Foreign Affairs and Trade*, 22 Sept. 2017, [dfat.gov.au/geo/bangladesh/development-assistance/Pages/development-assistance-in-bangladesh.aspx](http://dfat.gov.au/geo/bangladesh/development-assistance/Pages/development-assistance-in-bangladesh.aspx).

"Access to Healthcare in Bangladesh." *Summary: Access to Healthcare in Bangladesh*, American Bar Association, [www.impowr.org/content/summary-access-healthcare-bangladesh](http://www.impowr.org/content/summary-access-healthcare-bangladesh).

World Bank. 2010. *Understanding the dynamics of gender and nutrition in Bangladesh : implications for policy and programming (English)*. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/889931468003885567/Understanding-the-dynamics-of-gender-and-nutrition-in-Bangladesh-implications-for-policy-and-programming>

Johnson, Nancy L, et al. "Gender, Assets, and Agricultural Development: Lessons from Eight Projects." *Science Direct*, 24 Feb. 2016, [www.sciencedirect.com/science/article/pii/S0305750X16000073](http://www.sciencedirect.com/science/article/pii/S0305750X16000073).

"Creating Gender Responsive Agricultural Programs." Bill and Melinda Gates Foundation. <https://genderedinnovations.stanford.edu/Creating-Gender-Responsive-Agricultural-Development-Programs.pdf>